Space Weather Forecast

Issued on Saturday, 25 February 2023 at 00:50 Local

This forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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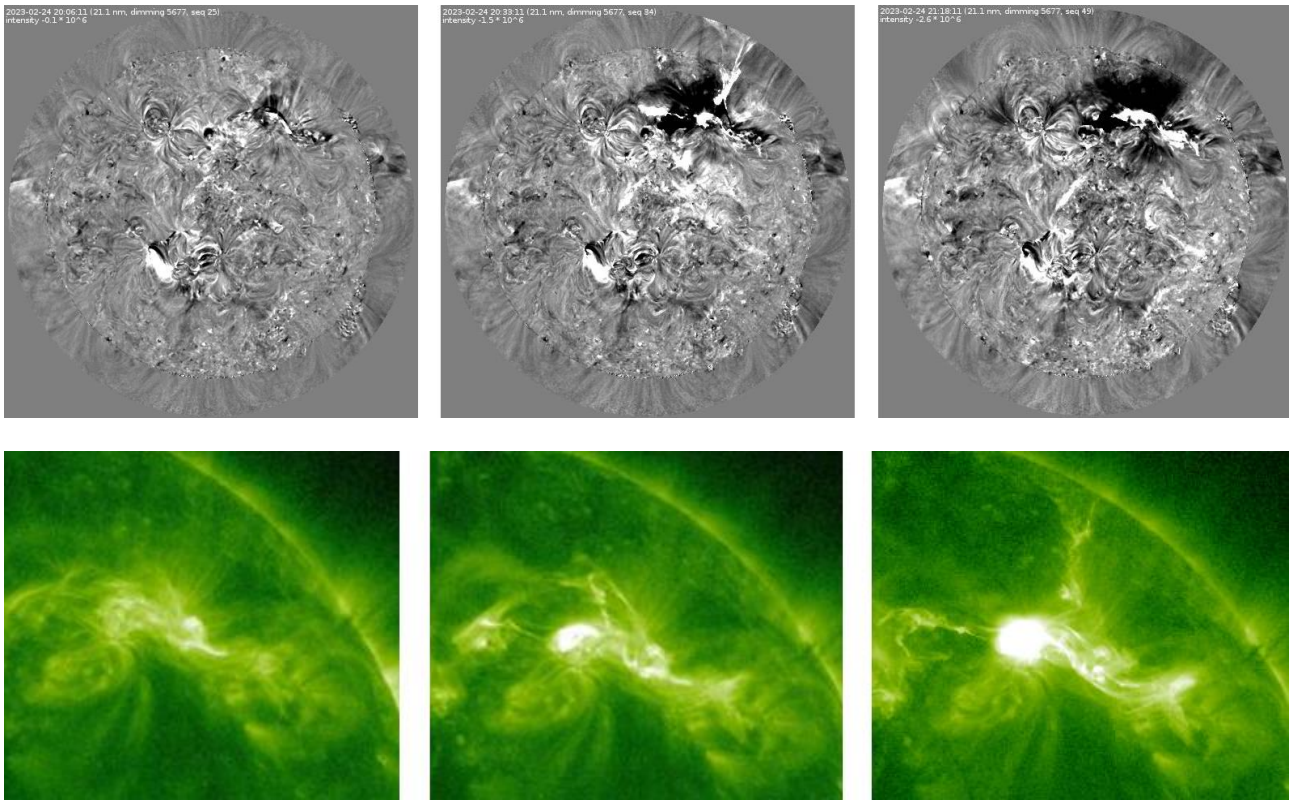
Space Weather Forecast Headline: Large CME undergoing assessment. Otherwise R1-R2/Minor-Moderate radio blackouts likely throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity rose to moderate in the UTC day of Friday 24 February, from a previous background of occasional mid-ranking Common-class flares. The most significant events were a small Moderate-class flare at 24/1715UTC from a sunspot group near the meridian in the northern solar hemisphere, but later and most notably a larger Moderate-class flare at 24/2030UTC from a large, long-period 'filament eruption' in the northwest. This filament had up to this point bisected one of the more significant sunspot regions on the disc (the now-faded remnant of the Strong-class flare producing group from 17 February) in an arrangement that has since proven to be unstable. A Coronal Mass Ejection (CME) was subsequently observed, with the shock visible heading initially above and ahead of the track of the Earth's orbit in early imagery. Full assessment of this potentially notable CME is pending.

Figure 1: Top: false colour time-integrated extreme UV imagery of the Moderate class flare and CME from the northwest of the Sun starting 24/2030UTC. Image processing courtesy of SIDC ROB. Bottom: Imagery sequence in false colour near X-ray wavelength of the same event. The resulting CME is undergoing assessment.



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The above was the most notable CME-generating event on the Sun in the period, however there were several earlier candidates. These included a 'disappearing filament' from the northern central disc at 24/0400UTC; a 'filament eruption' from the southeast at 24/0600UTC; a mid-ranking Common-class flare and 'coronal dimming' at 24/0709UTC in the northern central part of the Sun at 24/0700UTC. The northeastern solar horizon also saw a large and impulsive flare at 24/1245UTC, with a non-Earth directed CME then clearly visible on subsequent satellite imagery. The final event of note was a south-central hemisphere 'coronal dimming' at 24/1500UTC.

At the time of writing the M3.7 flare CME was awaiting imagery for assessment, however none of the other front-sided events had obvious ejecta associated with them.

There were six sunspot regions on the Sun in the period. The main changes in the period were significant proliferation, spreading and areal growth a spot group in the southeast; slight spreading, intermediate spot development and areal fading in the trailing portion of the largest group in the northeast; and proliferation of leading spots at the expense of fading trailers in the fading Strong-class producing spot group in the northwest. All remaining regions showed less noteworthy trends.

Solar Wind / Geomagnetic Activity: Solar winds were possibly indicative of a chaotic alternating switching behaviour between two streams of fast wind (of differing magnetic polarities). The solar wind speed showed a gradual decline from elevated levels finishing at slightly elevated levels. The number of particles in the solar wind fell a little to reach background levels in the period. The magnetic field associated with these particles fell from slightly elevated levels to background, while the north-south component's character changed from an erratic tendency before midday UTC, with a discontinuity then observed ahead of a smoother and mainly co-aligned field with Earth's into the UTC afternoon.

The net result of the above solar wind measures was provisionally quiet geomagnetic activity, below Minor Geomagnetic Storm G1 throughout and falling with time.

Energetic Particles / Solar Radiation: Solar radiation showed a rapid response to the northwest quadrant Moderate-class flare at 24/2030UTC, with 10MeV proton levels recorded at near-Earth satellites rising to a peak of 3.5pfu at 24/2400UTC - albeit short of the 10pfu required for Minor Solar Radiation Storm S1.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be moderate, with an ongoing slight chance of high activity, with the risk well-spread across most of the six current regions on the Sun, and therefore more reliably maintained throughout. None of the current regions leave in the period, and there are signs of further arrivals over the eastern horizon, meaning the risk of flares may increase into early next week, pending analysis.

Solar Wind / Geomagnetic Activity: There is one significant CME awaiting imagery for analysis - that associated with the Moderate-class flare at 24/2030UTC. Keeping abreast of the forecast is advised. Of probably much less import is a possible glancing blow from a CME that left the northwest of the Sun on 21 February, passing Earth's orbital radius as a possible glancing blow from the shock on day one, Saturday 25 February.

Earth is currently transiting a sector of space influenced by the tail end of a 'coronal hole' fast wind. There are two further coronal holes which are expected to influence solar winds over the next four days. Overall, it seems likely that wind speeds will be elevated or slightly elevated for much of this period, perhaps increasing to strong by day three (Monday 27 February).

Overall, there is a risk of Minor Geomagnetic Storm on all days, starting as a slight chance, but

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tentatively peaking with a chance to end the current UTC weekend and start the new working week. Note that there may also be some influence from the as yet unassessed CME.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is most likely to remain at background levels, but with an ongoing slight chance of reaching the S1 level.

Geomagnetic Storms:

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	30	30	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X Ray Flares:

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	60	60	60	60
Very Active	R3 to R5 X	No	10	10	10	10

Solar Radiation Storms - (High Energy Protons):

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	20	15	15	15
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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